IOWA STATE UNIVERSITY
Digital Press

Animal Industry Report

Animal Industry Report

AS 657

ASL R2629

2011

Induction of a Transient Chemically Induced Lameness in the Sow. Detection Using a Prototype Embedded Micro-computerbased Force Plate System

Anna K. Johnson
Iowa State University

Kenneth J. Stalder
Iowa State University

Robert F. Fitzgerald
Iowa State University

Steven J. Hoff
Iowa State University, hoffer@iastate.edu

Gang Sun
Iowa State University

Induction of a Transient Chemically Induced Lameness in the Sow. Detection Using a Prototype Embedded Micro-computerbased Force Plate System

Authors

Anna K. Johnson, Kenneth J. Stalder, Robert F. Fitzgerald, Steven J. Hoff, Gang Sun, Locke A. Karriker, and Johann Coetzee

Induction of a Transient Chemically Induced Lameness in the Sow. Detection Using a Prototype Embedded Micro-computer-based Force Plate System

A.S. Leaflet R2629

Anna K. Johnson, assistant professor;
Ken J. Stalder, associate professor;
Robert F. Fitzgerald, graduate research assistant,
Department of Animal Science;
Steve Hoff, professor, Agriculture and Biosystems Engineering Department;
Gang Sun, graduate research assistant,
Agriculture and Biosystems Engineering Department;
Locke A. Karriker, associate professor,
Veterinary Diagonostic and Production Animal Medicine,
Iowa State University, Ames, IA;
Johann Coetzee, associate professor, Kansas State University, KS

Summary and Implications

There are no approved drug treatments for analgesia use in swine, and the identification and validation of objective, repeatable pain measurements is fundamental for the development of effective analgesic drug regimens and management strategies for use in lame pigs. Induction of lameness allows for controlled evaluation of lameness pain in animals because pre- and post lameness measurements can be taken from the same animal, thereby reducing the confounding effects of individual differences. Therefore, the objective of this pilot study was to characterize differences in weight bearing that result from the amphotericin B chemical synovitis model in sows and test a prototype embedded prototype micro-computer based force plate system plate to determine its usefulness in detecting lameness in sows. A total of 24 mixed parity sows were used. Six sows were allocated to one of four treatment groups: sows that were injected on the front left hoof (n = 6), front right hoof (n = 6), rear right hoof (n = 6) and left rear hoof (n = 6). Each sow served as her own control and weight carried by each of all four legs was measured individually at all time periods. Pigs were anesthetized and injected with 10 mg of amphotericin B in both of the most distal interdigital joint spaces of the assigned foot. Data were collected on the embedded force plate the day before induction of lameness (D0; *baseline*), the day after induction (D2; *most lame*) and 7 days after induction of lameness (D8; *recovery and resolution of lameness*). Data for this pilot study was analyzed using the PROC MIXED procedure in SAS. When clinically sound (baseline; B) sows placed equal amount of weight over the four hooves, but on the day after injection when they were clinically the most severely lame, (L) regardless of the hoof treated, sows placed less weight on that injected hoof and dispersed their weight over the three unaffected hooves. Seven days after injection, lameness had resolved (R) clinically, and sows were placing equal weight over their four hooves as measured on the prototype (Figure 3a-d). This pilot study demonstrated that injection of 10 mg of amphotericin B in the distal interphalangeal joints of the foot causes clinical lameness in sows that is distinguishable from their pretreatment gait by observational lameness score and using an embedded micro-computer based force plate system. Additionally, this lameness spontaneously resolved in this study by 7-days post injection.

Introduction

Lameness has a significant impact on animal welfare including swine and is therefore considered one of the most important causes of culling for sows in the United States. Furthermore, gilts and sows that exit the breeding herd prior to return on their economic inputs result in a net monetary loss for the farm. Science-based guidance for the industry on optimal housing, management and treatment of lame pigs is deficient. There are no approved drug treatments for analgesia use in lame swine, and the identification and validation of objective, repeatable pain measurements is fundamental for the development of effective analgesic drug regimens and management strategies for use in lame pigs (AVMA; 2010; FDA, 2010). Research to address the limited knowledge in this area is essential to formulating science-based recommendations for pig producers. This will become especially important if legislative actions succeed in preventing downed animals from entering the human food chain (Prevention of Farm Animal Cruelty Act and the Healthy School Meals Act) regardless of etiology. Most research has focused on behavioral or physiological changes associated with acute pain (Anil et al., 2002; Ting et al., 2003; Stilwell et al., 2008), but these changes can be complex, with natural variation between animals complicating the differentiation of pain from other factors such as stress (Anderson and Muir, 2005). Induction of lameness allows for controlled evaluation of lameness pain in animals because pre- and post lameness measurements can be taken from the same animal, thereby reducing the confounding effects of individual differences. This approach has been published by Kotschwar et al., (2009). The authors concluded that the amphotericin B-induced synovitis model was a useful tool for studying changes associated with lameness in cattle through the use of pressure mats, heart rate and visual scoring of lameness. Therefore, the objective of this pilot study was to characterize differences in weight

bearing that result from the amphotericin B chemical synovitis model in sows and test a prototype embedded prototype micro-computer based force plate system plate to determine its usefulness in detecting lameness in sows.

Materials and Methods

This project was approved by the ISU Animal Care and Use committee (4-09-6709-S).

Animals and housing: To avoid aggression, 24 clinically normal, mixed parity were housed individually. Sows were acclimated to the facilities and environment for 7 d. Sows were purchased from a commercial producer in Iowa and housed in pens at Iowa State University. Each pen measured 3.7 m length x 1.4 m width x 1.2 m height. A rubber mat (2.5 m length x 2 cm height x 1.4 m width) was provided for sow comfort. Sows had *ad libitum* access to water via one nipple waterer that was positioned over a grate. Metal fences (1.9 m height x 76 cm width) were affixed at the end of each home pen and lights were on a 12:12 light dark cycle (light hours were between 0600 and 1800).

***Induction of lameness*:** Pigs were restrained in a standing position using a humane pig snare and anesthetized using a combination of Xylazine at 4.4 mg/kg (Anased®, Lloyd Laboratories, Shenandoah, IA, USA), Ketamine HCl at 2.2 mg/kg (Ketaset®, Fort Dodge Animal Health, Wyeth, Madison, NJ, USA), and Tiletamine HCl at 4.4 mg/kg (Telazol®, Fort Dodge Animal Health, Wyeth, Madison, NJ, USA) administered intramuscularly. The assigned toe was washed with mild soap and water to remove obvious fecal contamination, scrubbed for 3 min with an iodine based surgical scrub (Operand®, Aplicare Inc., Branford, CT, USA) using a 4 x 4 sterile gauze pad, and rinsed with 70% isopropyl alcohol until no evidence of the surgical scrub remained. Immediately after the onset of anesthesia, pigs were positioned in lateral recumbency and injection sites were rescrubbed. Ten mg of amphotericin B was injected in the most distal interdigital joint space in both left and right toe of one rear foot (Figure 1).

Figure 1. Injecting the distal interdigital joint space of the right rear toes of an anesthetized sow.

Treatments: Six sows were allocated to one of four treatment groups: sows that were injected on the front left hoof (n = 6), front right hoof (n = 6), rear right hoof (n = 6) and rear left hoof (n = 6). Each sow served as her own control and weight carried by each of all four legs was measured individually at all time periods.

Equipment: The Embedded Prototype Embedded Micro-computer-based force plate system was equipped with four separate load cells to measure the weight the sow puts on each limb while standing. A separation bar divided the area in half to limit the sow from placing more than one foot per load cell. The plate was coated with non-slip epoxy and was determined to be accurate to +/-0.45 kg (Figure 2). The device was designed to measure the ground reaction forces the pig exerts in a vertical plane on each individual foot. During the sampling periods, the force plate recorded all vertical forces the pig exerted on each foot while on the force plate.

Figure 2. Embedded Prototype Embedded Micro-computer-based force plate system.

Measures: Data was collected the day before induction of lameness (D0; *baseline*), the day after induction (D2; *most lame*) and 7 days after induction of lameness (D8; *recovery and resolution of lameness*). Data for this pilot study was analyzed using the PROC MIXED procedure in SAS. The forcepate measurements were recorded every 0.5 seconds for the entire sampling period.

Results

When clinically sound (baseline; B) sows distributed weight over the four hooves such that differences among the feet were not detected. On the day after injection when they were clinically the most severely lame, (L) regardless of the hoof treated, sows placed less weight on that injected hoof and dispersed their weight over the three unaffected hooves. Seven days after injection, lameness had resolved (R) clinically, and sows returned to the baseline pattern (Figures 3a-d).

Conclusions

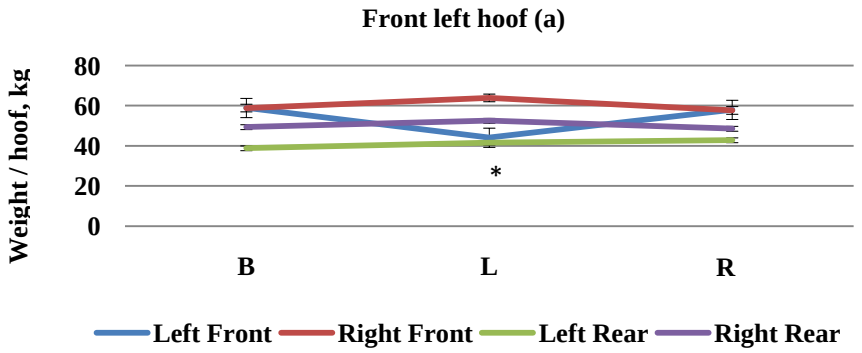
This pilot study demonstrated that injection of 10 mg of amphotericin B in the distal interphalangeal jointsof the foot causes clinical lameness in sows that is distinguishable from

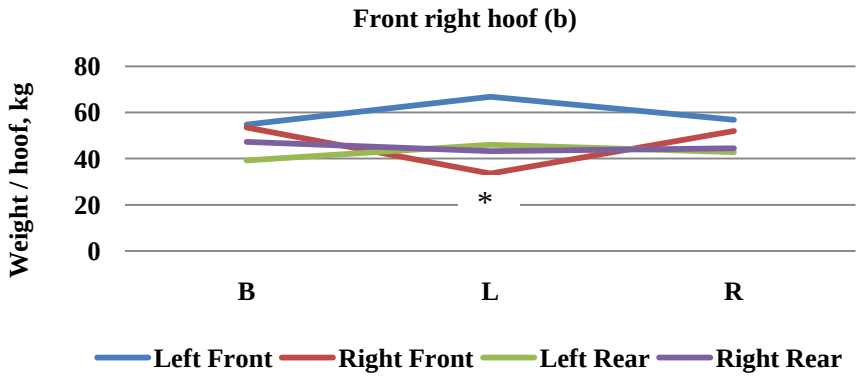
their pretreatment gait by observational lameness score and using an embedded micro-computer based force plate system. Additionally, this lameness spontaneously resolved in this study by 7-d post injection.

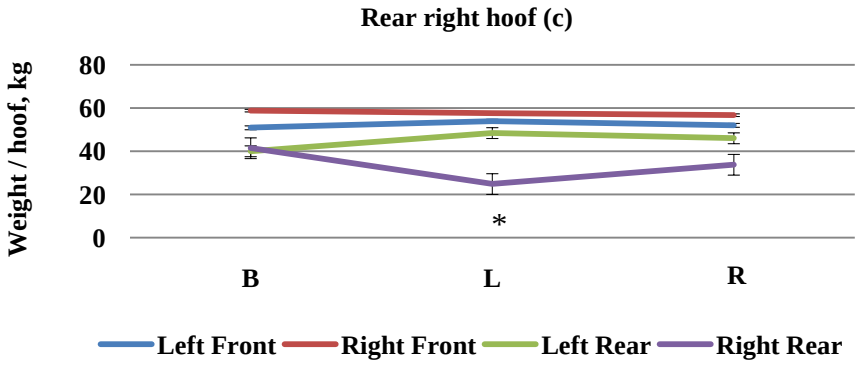
Acknowledgements

Support was provided by National Pork Board and the Iowa Pork Producers Association.

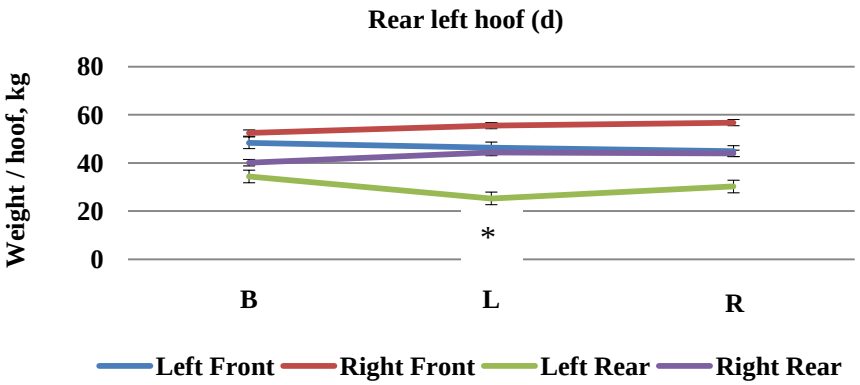
Figure 3. Sows were injected in the distal interphangeal joints with 10mg amphotericin B in either the front left hoof (a), front right hoof (b), rear right hoof (c) or rear left hoof (d). All lame days were different from baseline and resolution in all hooves at *P*<0.05.







Note; B = Baseline, L = Most lame or day after induction using a transient chemically model and R = resolution of lameness


Rear left hoof (d)
Weight / hoof, kg
80
60
40
20
0
*
B
L
R
Left Front
Right Front
Left Rear
Right Rear